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בקשה לפטנט
PATENT APPLICATION

אני, (שם המבקש, מענו - ולגבי גוף מאוגד - מקום התאגדותו)
I (Name and address of applicant, and, in case of body corporate, place of incorporation)

Pr. Edward G. Shifrin פר' אדוארד שיפרין
64, Ha'Shahar st. רח' השחר 64
Raanana, 43565 רעננה, 43565

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(באנגלית)
(English) **Supplementary Vascular Clamp For The Tool Kit Of The Open Approach Stapler**

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hereby apply for a patent to be granted to me in respect thereof.

*בקשת חלוקה- Application for Division	*בקשת פטנט מוסף- Application for Patent of Addition	*דרישת דין קדימה Priority Claim		
מבקשת פטנט from application	לבקשה/לפטנט to Patent/Appl.	מספר/סימן Number/Mark	תאריך Date	מדינת האיגוד Convention Country
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פר' אדוארד שיפרין
רח' השחר 64, רעננה, 43565

חתימת המבקש
Signature of Applicant

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17	מרץ	2003

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SUPPLEMENTARY VASCULAR CLAMP FOR THE TOOL KIT OF THE OPEN APPROACH STAPLER

Inventors: **Edward G. SHIFRIN,**
64, Hashahar St., 43565 Raanana, Israel;

Mordehy D. SHVARTSMAN,
3, Harav Mashash St., Apt. 1, 32167 Haifa, Israel;

Mark A. UMANSKY,
20, Mordehy Anilevitch St., Apt. 8, 35025 Haifa, Israel;

Gennady S. NICKELSHPUR,
9-D Habastiliya St., Apt. 9, 35597 Haifa, Israel.

Applicant : **Edward G. SHIFRIN,**
64, Hashahar St., 43565 Raanana, Israel.

SUPPLEMENTARY VASCULAR CLAMP FOR THE TOOL KIT OF THE OPEN APPROACH STAPLER

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to medicine, particularly to clamps applied in vascular surgery for occluding blood vessels during a surgical procedure, in particular, to vascular clamps applied in aortic aneurysm repair.

2. Background of the Invention

[0002] Vascular clamps are very important in surgeries on blood vessels. Most commonly they serve for occlusion of a blood vessel by its jaws or other actuators, which permits to stop blood flow at the operated portion of this blood vessel. In particular, vascular clamps are known according to US patents 4,531,519; 5,152,770; 5,282,812.

[0003] Dunn and Scarrow in U.S. Pat. 4,531,519 disclose a vascular clamp in the form of a tapering, flexible and tubular envelope which is wound around the blood vessel to be occluded and is inflated by air or another fluid.

[0004] Bengmark and Persson in U.S. Pat. 5,152,770 describe a similar device, which includes a flexible, elongate strip covered on its one side with a plurality of communicating bulbs. The strip is wound around the blood vessel or duct to be occurred and the bulbs are inflated to a pressure serving to occlude the duct. After deflation of the bulbs the strip is removed to allow the duct to re-open. As in previous vascular clamp, the application of the strip or envelope by winding it around the blood vessel and subsequently inflating it until the flow of blood or other body fluid is stopped, is a difficult and time consuming task. For this reason both devices are used in exceptional cases only.

[0005] Suarez in U.S. Pat. 5,282,812 discloses a vascular clamp in the form of a strip of metal bent into V-shape with its inside surfaces lined with a resilient material. Closing of a vessel is described, whereby the clamp is to be held in a forceps, to be pushed over the vessel to be occluded and pressed onto the vessel, whereafter the forceps is removed. The material of the strip is supposed to keep its shape after removal of the forceps and to maintain the necessary pressure during the operation. The device is provided with means for engaging the forceps jaws after completed surgery for opening the V and for removing the clamp. It is claimed that the strip material would have a positional memory for exerting the necessary pressure after positioning. This would require a different size and material of the device for every size of vessel and blood pressure.

[0006] Most of the known vascular clamps have two intersecting levers pivotally mounted on a common pivot pin and provided with clamping jaws at their first ends, as well as with levers having fixing grips at their second ends, such as vascular clamps disclosed in Canada patent 1103119 and US patent 5,624,454.

[0007] Muermans and Rivlin in Canadian Patent 1103119 disclose a surgical clamp having two clamping jaws and comprising a soft pad placed over each jaw. Each pad includes two cavities one of them tightly located over the respective jaw the second cavity is filled with a fluid or solid and is subsequently sealed. It is claimed that the device clamps the vessel without damage.

[0008] Devices described in US Pat. 3,503,398 and 5,236,437 also have soft pads on the inner surface of its clamping jaws to prevent injury to the outer surface of blood vessels. These soft members are adapted to be filled with a liquid or gaseous fluid, see U.S. Pat. 5,236,437.

[0009] All the above devices serve to close a blood vessel portion during an operation to prevent blood flow over this portion.

[0010] Closest to the claimed device is "Padded vascular clamp" according to US Pat. 5,624,454. Palti and Schnall in U.S. Pat. 5,624,454 disclose a vascular clamp for occluding a blood vessel or duct in a human or animal. The vascular clamp includes a pair of a pivoting arms with a clamping jaw rigidly attached to a distal end of each pivoting arm. A concave substantially semi-cylindrical chamber is formed in each clamping jaw. The clamping jaws are movable between an open position and a closed position, and are aligned so as to form a substantially cylindrical chamber in the closed position. A balloon is mounted in the concave semi-cylindrical chamber of each clamping jaw. Each balloon includes a substantially semi-cylindrical rigid shell conforming to the concave semi-cylindrical chamber and a thin, elastic material pre-filed with a liquid or gaseous fluid at a predetermined pressure. The balloons are configured to completely surround and occlude the blood vessel or duct in the closed position of the vascular clamp. The rigid shell of each balloon is attached to its associated clamping jaw.

[0011] A distinction of the described vascular clamp is that its design allows to adjust the extent of occluding a blood vessel within a wide range - from simply occluding the blood vessel to completely closing its lumen to stop blood flow.

[0012] The vascular clamp suggested by us has a function different from that of known vascular clamps. It serves to surround and press the outer surface of a blood vessel at the moment of performing a surgery, when within the blood vessel there is located a special endovascular stapler for suturing a prosthesis-graft or stent-graft to the wall of a blood vessel, substantially the aorta, in direction from the inside to the outside via metal staples. Hence the claimed vascular clamp is provided for other purposes.

[0013] An object of the present invention is to provide intraaortal bending of the ends of staples ejected from an open approach endovascular stapler during the surgical procedure for suturing a prosthesis – graft or stent-graft to the wall of a blood vessel, substantially the aorta.

[0014] Another object of the invention is secure surrounding of aorta walls by clamping jaws of the claimed vascular clamp which provides closing a possible gap between the inner surface of clamping jaws and outer surface of the aorta and at the same time prevents injury to the outer surface of aorta walls.

[0015] A third object of the claimed invention is to correct non-uniformity in the thickness of aorta walls in the process of setting the claimed vascular clamp.

SUMMARY OF THE INVENTION

[0016] The subject-matter of the present invention is a supplementary vascular clamp for the tool kit of the open approach stapler and serving to occlude a blood vessel around this open approach stapler at the moment of its operation.

[0017] The vascular clamp comprises: a) a pair of rotatable levers, b) tightening means for providing intraaortal bending of staple ends, c) fastener means for attaching the tightening means to a corresponding clamping jaw, and d) compensating means for correcting the non-uniformity in the thickness of aorta walls.

[0018] In the claimed clamp each of the rotatable levers has a proximal end and a distal handle end. Each rotatable lever contains clamping jaws rigidly attached to a corresponding proximal end of this lever and shaped as a concave semi-cylindrical cavity. The clamping jaws are adapted to move between an open position and a closed position, defining a through cylindrical cavity in closed position.

[0019] The rotatable levers intersect and are connected via a pivot pin at the point of intersection, near their proximal ends. These rotatable levers contain fixing grips near their distal handle ends.

[0020] Each clamping jaw of the vascular clamp is shaped as a concave semi-cylindrical cavity having a concave inner surface and bent outer surface, substantially parallel with its inner surface. The clamping jaws are adapted to be rigidly attached to the proximal ends of rotatable levers of conventional vascular clamps.

[0021] The vascular clamp also has a tightening means for intraaortal bending of staple ends of the open approach stapler and for securely surrounding the aorta walls via clamping jaws. The tightening means contains at least two plates of resilient material, substantially rubber or plastic and each of them is attached to the inner semi-cylindrical surface of a corresponding clamping jaw. To this end the vascular clamp is provided with fastener means for attaching the tightening means to corresponding clamping jaws.

[0022] In another embodiment the tightening means contains at least one strip of resilient material, substantially rubber or plastic, which is rigidly attached by each of its ends to the inner semi-cylindrical surface of a corresponding clamping jaw.

[0023] And finally, the tightening means may be formed as at least one strip of resilient material, substantially rubber or plastic, which is adapted to adjust the force of occluding the outer surface of a blood vessel. For this purpose the vascular clamp is provided with a mechanism for tensioning this strip.

[0024] The vascular clamp also has a compensating means for correcting non-uniformity in the thickness of aorta walls. It contains substantially a ridge at the free end of one of the clamping jaws and a valley opposite to this ridge at the corresponding free end of the second clamping jaw.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The invention will now be described in conjunction with the following drawings in which like reference numerals designate like elements and wherein:

[0026] FIG. 1 is a perspective view of a supplementary vascular clamp according to the first embodiment of the present invention;

[0027] FIG. 2 shows the working part of the claimed vascular clamp in its working position;

[0028] FIG. 3 shows a general view of the working part of the claimed vascular clamp according to the first embodiment;

[0029] FIG. 4 shows a general view of the working part of this vascular clamp according to the second embodiment;

[0030] FIG. 5 shows the free end of this working part of claimed vascular clamp with a compensating means.

DETAILED DESCRIPTION OF THE DRAWINGS

[0031] The preferred embodiments of the present invention are described below. The inventors of the present subject matter contemplate that the embodiments described herein are capable of use in the repair of other vessels and in other procedures. Thus, it is intended that the present invention cover the modifications and variations of the invention, provided they come within the scope of the appended claims and their equivalents.

[0032] The most preferred embodiments of a supplementary vascular clamp, according to the present invention, are shown in drawing figures 1 - 5.

[0033] The claimed supplementary vascular clamp **1** (FIG. 1) comprises a pair of rotatable levers **10** and **12**. Each of rotatable levers **10** and **12** has a proximal end, **14** and **16** respectively, and distal handle end, **18** and **20** respectively. Each rotatable lever contains clamping jaws, **22** and **24** respectively, rigidly attached to a corresponding proximal end **14** and **16** of this lever **10** or **12** and shaped as a concave semi-cylindrical cavity. Clamping jaws **22** and **24** are movable between open position (FIG. 1) and closed position (FIG. 2). Clamping jaws **22** and **24** define in closed position a through cylindrical cavity **26** (FIG. 2).

[0034] Rotatable levers **10** and **12** cross one another and are connected via pivot pin **28** at the point of their crossing, near their proximal ends **14** and **16** (FIG.1 and 2). Rotatable levers **10** and **12** contain fixing grips **30** and **32** near their distal handle ends **18** and **20** (FIG. 1).

[0035] Each clamping jaw **22** and **24** of vascular clamp **1** (FIG.2) is shaped as a concave semi-cylindrical cavity having a concave inner surface, **34** and **36** respectively, and a curved outer surface, **38** and **40** respectively, substantially parallel with its inner surface **34** and **36**. Clamping jaws **22** and **24** are adapted to be rigidly connected with proximal ends **14** and **16** of rotatable levers **10** and **12** of conventional vascular clamps (FIG. 1, 2).

[0036] Vascular clamp **1** also has a tightening means for providing intraaortal bending staple ends of the open approach stapler and securely surrounding by clamping jaws **22** and **24** the aorta walls (FIG. 3). The tightening means contains at least two plates of resilient material, substantially rubber or plastic, **42** and **44** respectively, each of them being attached to the inner semi-cylindrical surface **34** and **36** of a corresponding clamping jaw **22** and **24**. To this end vascular clamp **1** is provided with fastener means for securing plates **42**, **44** of this tightening means to a corresponding clamping jaw **22** or **24**. These fastener means may be screws **46** (FIG. 3). Fastener means may be also formed as glue layers or adhesive means.

[0037] The tightening means may be also formed as at least one strip **48** of resilient material, substantially rubber or plastic (FIG. 4). This strip **48** is rigidly attached to the inner semi-cylindrical surface **34** and **36** of a corresponding clamping jaw **22** and **24** by each of its ends **50** and **52**.

[0038] And finally, the tightening means may contain at least one strip **48** of resilient material, substantially rubber or plastic, adapted to adjust the force of occluding the outer surface of a blood vessel. For this purpose the ends of strip **50** and **52** may be lengthened to come onto curved outer surfaces **38** and **40** of clamping jaws **22** and **24**, and vascular clamp **1** is provided with a mechanism for tensioning said strip, this mechanism including one or two conventional

tensioning devices **54** attached to one or two curved outer surfaces **38** or **40** (FIG. 4).

[0039] The vascular clamp may also have a compensating means for correcting non-uniformity in the thickness of walls of aorta or other blood vessel. It contains substantially a ridge **56** at the free end of one of the clamping jaws, for instance **22**, and valley **58** opposite to this ridge, at a corresponding free end of the second clamping jaw **24** (FIG. 5).

[0040] The claimed device works as follows.

[0041] In a surgical operation, the aorta or some other blood vessel is exposed. Within this blood vessel there is inserted a prosthesis , such as a graft or stent-graft, and a means for securing this prosthesis to the blood vessel wall, such as an open approach stapler. Then a supplementary vascular clamp **1** is applied onto the outer surface of this blood vessel. At the moment of applying vascular clamp **1** its proximal ends **14** and **16** with clamping jaws **22** and **24** are located on both sides of the operated blood vessel, whereafter, due to forces applied to distal handle ends **18** and **20**, levers **10** and **12** turn about pin **28** to bring together clamping jaws **22** and **24**. Clamping jaws **22** and **24** form in their closed position a through cylindrical cavity **26** enclosing the blood vessel. Every effort is made to position the supplementary vascular clamp **1** in such a way that it should be

located by its clamping jaws **22** and **24** concentrically with the actuator of open approach stapler in the area of ejecting its staples. Then the position of clamp **1** is fixated by fixing grips **30** and **32**, selecting such a position of their mutual connection which provides sufficiently tight occlusion of the outer surface of blood vessel by clamping jaws **22** and **24**.

[0042] Then the open approach stapler is actuated to suture by staples the prosthesis to the inner surface of blood vessel (not shown in the drawings). At the moment of the open approach stapler operation the tightening means of supplementary vascular clamp **1** containing plates **42**, **44** or strip **48** tightly encloses the outer surface of blood vessel to prevent the surface from injuries and simultaneously provide the predetermined bending of staple ends of the stapler. The compensating means containing a ridge **56** and valley **58** at the ends of clamping jaws **22** and **24** provides correction of non-uniformity in the thickness of walls of an operated blood vessel, in particular, the aorta.

[0043] The claimed supplementary vascular clamp is developed as a device contained in the tool kit of an open approach stapler. At the same time, this clamp may be used for operation with other endovascular staplers. The claimed stapler may be also used for operation with other tools, applied in particular for cavitary operations, such as operations on the intestine.

[0044] While this invention has been described in conjunction with specific embodiment thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, the preferred embodiments of the invention as set forth herein are intended to be illustrative, not limiting. Various changes may be made without departing from the spirit and scope of the invention as defined in the following claims.

Claims

1. A supplementary vascular clamp for the tool kit of an open approach stapler serving to occlude a blood vessel around this open approach stapler at the moment of its operation, comprising:

a) a pair of rotatable levers each of them having a proximal end and a distal handle end, clamping jaws rigidly attached to a corresponding proximal end of this lever and shaped as a concave semi-cylindrical cavity, the clamping jaws being movable between an open position and closed position, the clamping jaws forming a through cylindrical cavity in closed position;

b) a tightening means to provide intraaortal bending of the ends of staples of said open approach stapler and secure surrounding the aorta walls by clamping jaws;

c) fastener means for attaching the tightening means to a corresponding clamping jaw;

d) a compensating means for correcting non-uniformity in the thickness of aorta walls,

whereby there are provided intraaortal bending of the ends of staples of said open approach stapler secure surrounding aorta walls by the clamping jaws as well as correcting non-uniformity in thickness of aorta walls.

2. A supplementary vascular clamp according to claim 1, wherein said rotatable levers cross one another and are connected via a pivot pin at the point of their crossing, the rotatable levers containing fixing grips near their distal handle ends.

3. A supplementary vascular clamp according to claim 1, wherein said rotatable levers cross one another and are connected via a pivot pin near their proximal ends.

4. A supplementary vascular clamp according to claim 1, wherein each said clamping jaw is shaped as a concave semi-cylindrical cavity having a concave inner surface and a bent outer surface, substantially parallel with its inner surface.

5. A supplementary vascular clamp according to claim 1, wherein the clamping jaws are adapted to be rigidly connected with the proximal ends of rotatable levers of conventional vascular clamps.

6. A supplementary vascular clamp according to claim 1, wherein said tightening means serving to provide intraaortal bending of the ends of staples of said open approach stapler and secure surrounding the aorta walls by said clamping jaws contains at least two plates of resilient material, substantially rubber or plastic,

each of the plates being secured to the inner semi-cylindrical surface of a corresponding clamping jaw.

7. A supplementary vascular clamp according to claim 1, wherein said tightening means serving to provide intraaortal bending of the ends of staples of said open approach stapler and secure surrounding of the aorta walls by said clamping jaws contains at least one strip of resilient material, substantially rubber or plastic, rigidly secured by each of its ends to the inner semi-cylindrical surface of a corresponding clamping jaw.

8. A supplementary vascular clamp according to claim 7, wherein said tightening means serving to provide intraaortal bending of the ends of staples of said open approach stapler and secure surrounding of the aorta walls by clamping jaws containing at least one strip of resilient material, substantially rubber or plastic, is capable of adjusting the force of occluding the outer surface of a blood vessel.

9. A supplementary vascular clamp according to claim 8, wherein said tightening means serving to provide intraaortal bending of the ends of staples of said open approach stapler and secure surrounding of the aorta walls by clamping jaws containing at least one strip of resilient material, substantially plastic is capable of adjusting the force of occluding the outer surface of a blood vessel via device for tensioning said strip.

10. A supplementary vascular clamp according to claim 1, wherein said compensating means for correcting non-uniformity in the thickness of aorta walls contains a ridge at the free end of one of said clamping jaws and a valley opposite to this ridge at a corresponding free end of the second clamping jaw.

ABSTRACT

The present invention relates to medicine, in particular, to clamps used in vascular surgery for occluding blood vessels during a surgical operation, such as vascular clamps used in aortic aneurysm repair. The claimed supplementary vascular clamp comprises a pair of rotatable levers, each of them having a proximal end and a distal handle end. Each rotatable lever contains clamping jaws rigidly attached to a corresponding proximal end of this lever and shaped as a concave semi-cylindrical cavity. The clamping jaws are movable between an open position and a closed position. The clamping jaws define, in closed position, a through cylindrical cavity. The clamping jaws of the vascular clamp are also provided with a tightening means to provide intraaortal bending of the ends of staples of an open approach stapler. The tightening means is shaped as plates or a strip of resilient material. The strip may be provided with a tensioning device. The vascular clamp may be also provided with a compemsating means for correcting non-uniformity in the thickness of aorta walls.

10 Claims, 5 Drawing Figures

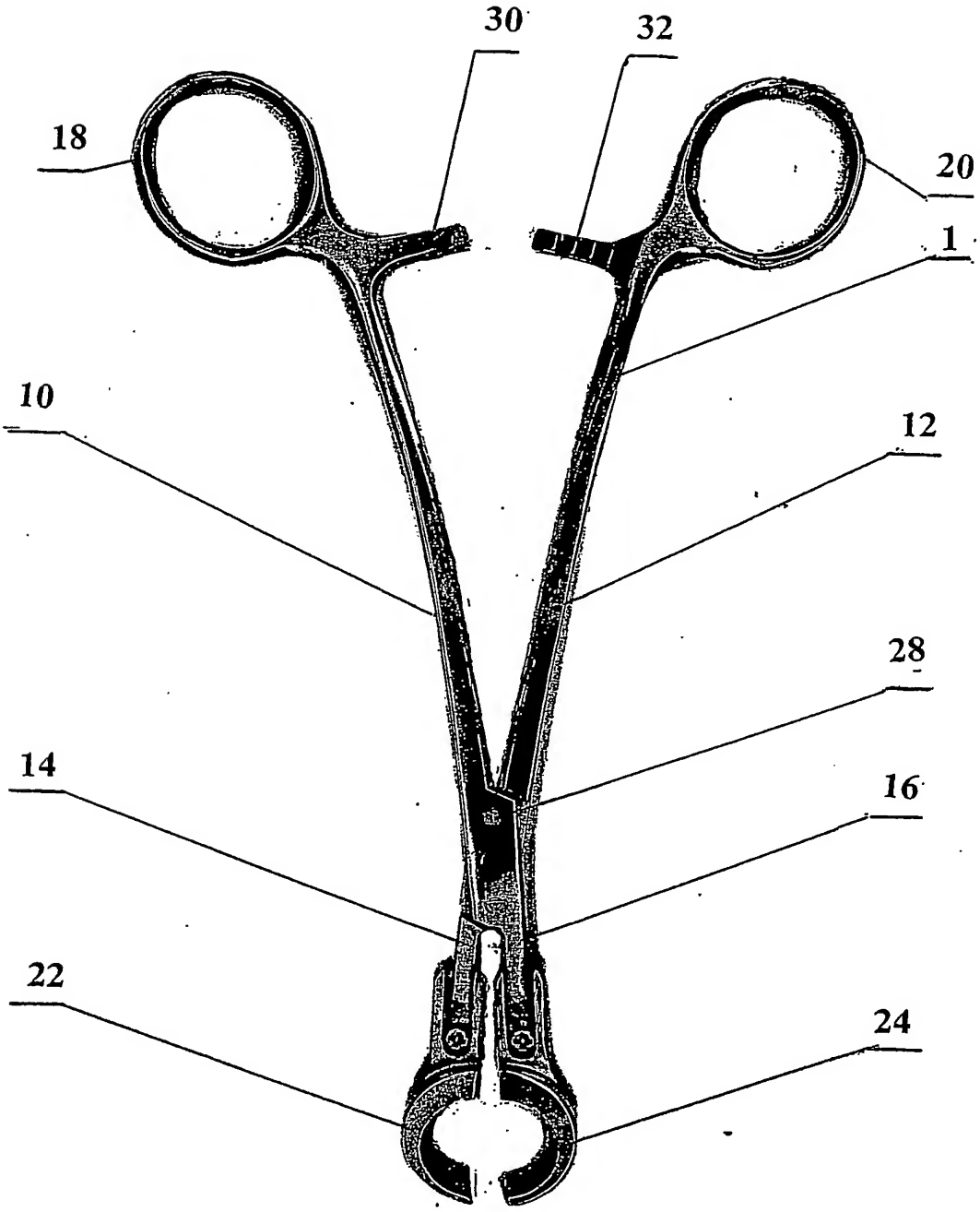

FIG. 1

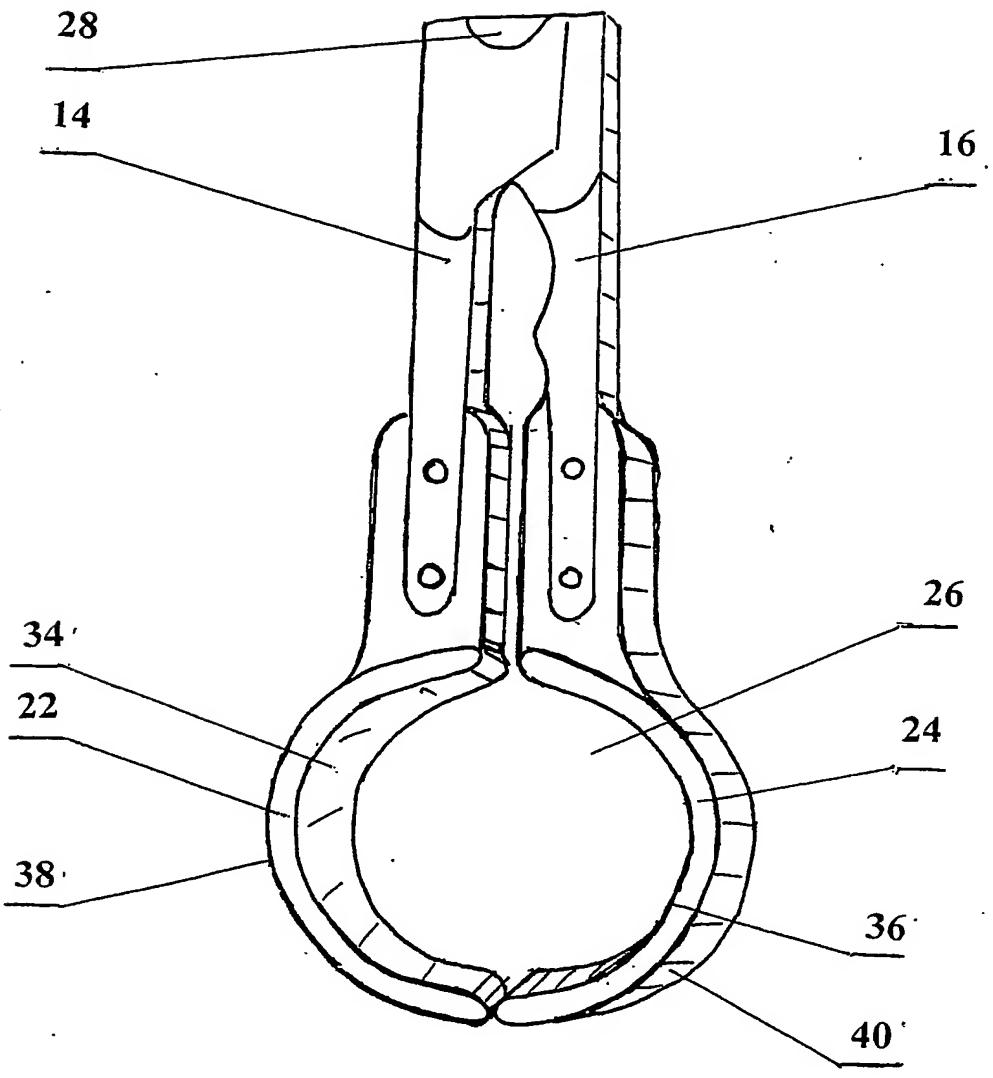

FIG. 2

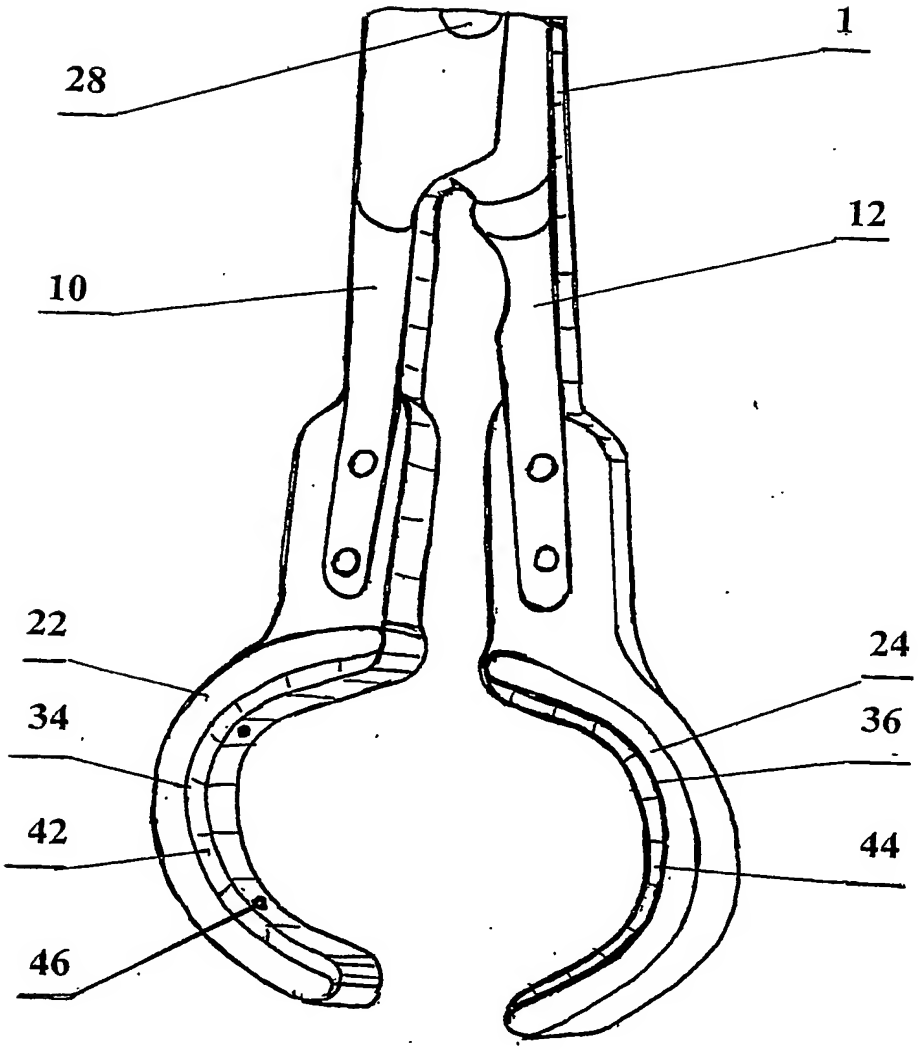

FIG. 3

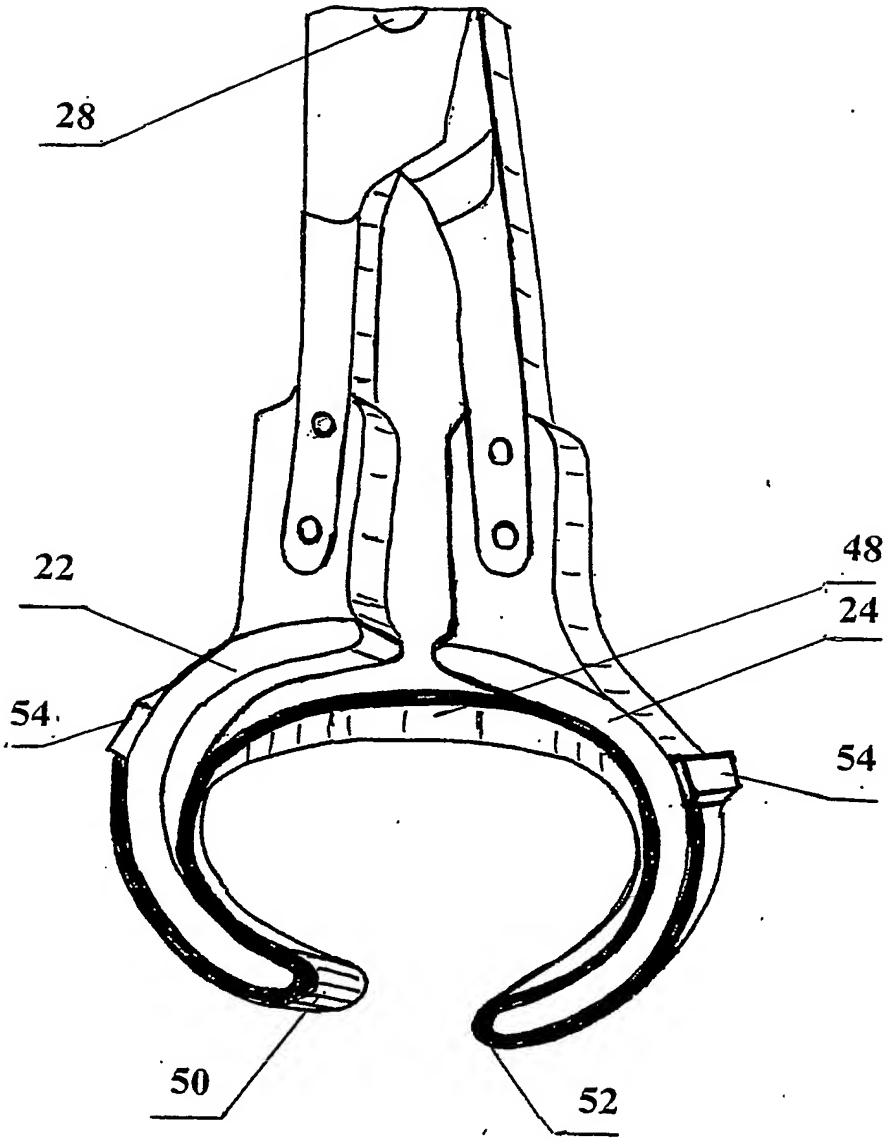

FIG. 4

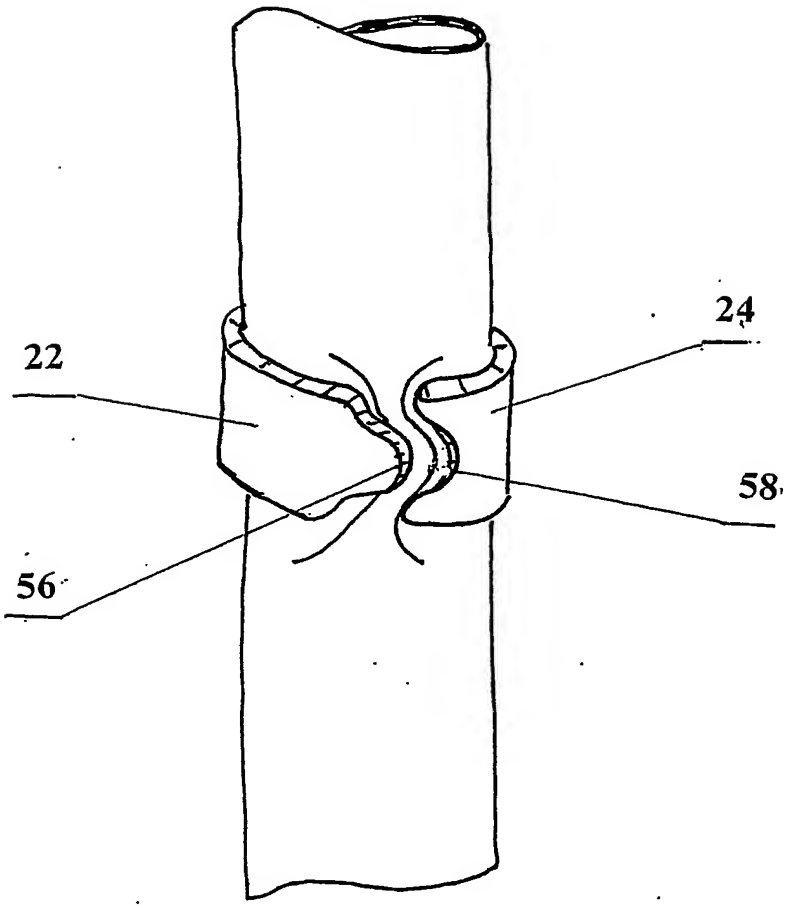

FIG. 5

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